IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: GANDEL; Pierre

SERIAL NO.: 10/505,246 ART UNIT: 2834

FILED: April 22, 2005 EXAMINER: Preston, E.D.

TITLE: LINEAR ACTUATOR COMPRISING A BRUSHLESS POLYPHASE ELECTRIC MOTOR

Amendment D: REMARKS

Upon entry of the present amendments, previous Claims 36 - 44 have been canceled and new Claims 45 - 53 substituted therefor. Reconsideration of the rejections, in light of the forgoing amendments and present remarks, is respectfully requested. The present amendments have been entered for the purpose of distinguishing the present invention from the prior art.

In the Office Action, it was indicated that Claims 36 - 38 and 40 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the Miller patent and the Okabe Japanese patent. Claim 36 was rejected under 35 U.S.C. § 103(a) as being unpatentable over the Miller patent and the Okabe Japanese patent and further in view of the Akagi patent. Claim 41 was rejected under 35 U.S.C. § 103(a) as being unpatentable over the Miller patent and the Okabe Japanese patent in view of the Lamb patent. Claims 43 and 44 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the Miller patent and the Okabe Japanese patent in view of the Huber patent. Importantly, it was indicated that Claim 42 was "objected to" as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

As an overview to the present reply, Applicant has revised previous independent Claim 36

in the form of new independent Claim 45. New independent Claim 45 expresses the previous limitations and includes certain limitations so as to conform the present claim language with that of the corresponding European patent and also for the purpose of more clearly distinguishing the present invention from the prior art. In particular, the driving means is described as converting a rotational movement of the electric motor into a "linear and reversible" displacement of said control organ. There is a "reversible reduction mechanism independent of and cooperative with said driving means" as positively recited apart from the "driving means". Applicant respectfully contends that these features serves to distinguish the present invention from the prior art references.

A copy of the claims from the corresponding European patent are attached hereto. In particular, in Claim 1 of the referenced European patent, it is indicated that the "driving means" is "associated" with an "independent reversible reduction device". As such, it is quite clear from independent Claim 1 of the European patent that the independent reversible reduction device is an item that is cooperative with the driving means and is independent of the driving means. As such, such language has been incorporated into independent Claim 45 herein.

In the Official Action, the Examiner stated that the Miller patent teaches that "the drive means includes an independent reversible reduction means, being the balls and ball nut 102 . . " Applicant respectfully disagrees with this analysis. The balls and the ball nut are the "driving means" within the meaning of the "driving means" in independent Claim 45. The balls and the ball nut of the Miller patent are designed for converting the rotational motion of the rotor into linear movement of the shaft. In the Miller patent, there is no "independent" reversible reduction device. As such, there is no "reversible reduction mechanism" that is "cooperative with and independent of" the driving means. This feature is neither shown in the Miller patent, nor any of the other prior art

references.

In some cases, it is necessary to obtain an important reduction between the rotation of the rotor and the linear displacement of the actuator or shaft. In such a case with screws and nuts, as described in the prior art patent cited by the Examiner, the threads per inch (or "pitch) must be so high to obtain this important reduction such that the system would no longer be reversible.

In contrast, in the present invention, there is a "independent reversible reduction mechanism" cooperative with another device, i.e. the driving means. It is designed to be capable of converting the rotational motion of the rotor into a linear movement and in a reversible manner.

As was stated in paragraphs [0066] - [0066] of the original specification:

> Furthermore, it has advantageously been devised to distinguish, at least partly, the motion-conversion and reduction functions, by associating with said driving means 5 and independent reversible reduction device 43.
>
> As can be seen in figures 4 and 5, such a reversible reduction device can adopt the form of an epicyclical gear 44 through which rotor 4 attacks, according to the embodiment of figure 4, the nut 16 engaged with the threaded rod 17, the latter being designed with a large pitch and therefore perfectly reversible. In the design according to figure 5 is used a system 14A comprised of a roller 40 and a cam 41.

The benefit of such a structure was recited in paragraphs [0079] - [0081] of the original specification:

> Moreover, this conversion technique allows to avoid blocking in rotation the roller defined by the pin, this contrary to the traditional helical systems. Hence, it avoids the losses due to friction this type of blocking normally generates and the mechanical output is therefore increased accordingly.
>
> Finally, this particular motion conversion has the following advantages:
>
> - a larger motion conversion than that achieved with a traditional system with only one helical profile or screw and nut, and
> - a higher output than these same systems.
>
> The design shown in figure 8 allows to note that these two concepts of

differential drive and conversion with double helix are easily matched and allow achieving an interesting actuator in terms of reduction of motion, output and compactness.

On this basis, Applicant contends that the present invention, as defined by independent Claim 45, is patentably distinguishable from the combination of Miller and Okabe Japanese patent. The present invention, as defined by independent Claim 45, is different in structure, function and results achieved from that of the prior art combination of references. Dependent Claims 46 - 53 herein correspond, respectively, to the limitations of previous dependent Claims 37 - 44.

Based upon the foregoing analysis, Applicant contends that independent Claim 45 is now in proper condition for allowance. Additionally, those claims which are dependent upon independent Claim should also be in condition for allowance. Reconsideration of the rejections and allowance of the claims at an early date is earnestly solicited. Since no new claims have been added above those originally paid for, no additional fee is required.

Respectfully submitted,

July 10, 2008
Date

/Andrew W. Chu/

John S. Egbert; Reg. No. 30,627
Andrew W. Chu; Reg. No. 46,625
Egbert Law Offices PLLC
412 Main Street, 7th Floor
Houston, Texas 77002
(713)224-8080
(713)223-4873 fax

Customer No. 24106

die Spule (9) der entsprechenden Phase (10) trägt, wobei die besagten zentralen statorischen Pole (8) der beiden W-förmigen Kreise und entsprechend jeweils einer Phase winklig in 120° beabstandet seien.

Claims

1. Linear actuator comprising a brushless multiphase synchronous electric motor (2) including a stator (3) and a rotor (4), the latter acting on a control organ (O) through driving means (5) designed capable of converting, over several revolutions, its rotational movement into a linear displacement, **characterised in that** :

   - it includes springy and/or magnetic restoring means (21) designed capable of systematically restoring the control unit (O) into a reference position in the event of interruption of the power supply to the motor (2) ;
   - the motor (2) includes a position-detection device (25 ; 25A) contributing, in combination with an electronic control unit, to the control or the adjustment of the position of the rotor (4), hence of the control organ (O) ;
   - and with the driving means (5), designed capable of converting the rotational motion of the rotor (4) into a linear movement, is associated an independent reversible reduction device (43).

2. Linear actuator according to claim 1, **characterised in that** the springy and/or magnetic restoring means (21) are in the form of at least one springy and/or magnetic element (22) for controlling the rotation of the rotor (4) designed capable, by an action on the latter, of restoring the control organ (O), starting from any position previously imparted to it by the motor (2), into said reference position.

3. Linear actuator according to any of the preceding claims, **characterised in that** the springy and/or magnetic restoring means (21) are defined by a springy and/or magnetic element (23) designed capable of acting directly on the control organ (O) in order to restore it, starting from any position imparted to it by the motor (2), into said reference position.

4. Actuator according to claim 1, **characterised in that** the springy and/or magnetic restoring means (21) are defined in the form of a combination of a springy and/or magnetic element (22) for controlling the rotation of the rotor (2) and of a springy and/or magnetic element (23) acting directly on the control organ (O), this so as to restore this control organ (O) into a reference position, starting from any position previously imparted to it by the motor (2).

5. Linear actuator according to any of the preceding claims, **characterised in that** the driving means (5) designed capable of converting the rotational motion of the rotor (4) into a linear movement are designed of a reversible type.

6. Linear actuator according to any of the preceding claims, **characterised in that** the driving means (5) designed capable of converting the rotational movement of the rotor (4) into a linear movement are defined by a screw and nut system (14), the rotor (4) including, at the level of an axial bore (15) a nut (16) engaged with a coaxial threaded rod (17 ; 17A ; 17B) designed capable of defining, directly or indirectly, the control organ (O).

7. Linear actuator according to claim 6, **characterised in that** the nut (16) carried by the rotor (4) is mounted moveably on a fixed threaded rod (17B) so as to be capable of moving, according a helical motion, under the stator (3) and of transmitting its linear displacement to the control organ (O) immobilised in rotation by adequate means.

8. Linear actuator according to claim 6 or 7, **characterised in that** the screw and nut system (14) is of the ball screw type with low friction coefficient.

9. Linear actuator according to any of claims 1 to 5, **characterised in that** the driving means (5) designed capable of converting the rotational motion of the rotor (4) into a linear displacement adopt the form of a system (14A) of the type roller (40) and cam (41), the roller (40) associated with the control organ (O) evolving along a circular cam (41) put into rotation, directly or indirectly, by the rotor (4).

10. Linear actuator according to any of claims 1 to 5, **characterised in that** the driving means (5) designed capable of converting the rotational motion of the rotor (4) into a linear displacement include a first cam (41) and a second cam (41A) with crossed profiles designed capable of being rotated with a differential speed, in order to impart to a roller (40A), in the form of a pin, an axial sliding capable of causing the translation of the control organ (O).

11. Linear actuator according to any of the preceding claims, **characterised in that** the detection device (25) consists of magneto-sensitive elements, such as Hall sensors (26), integrated into the stator (3) of the motor (3) so as to be capable of detecting the magnetic poles (7) of the rotor (4).

12. Linear actuator according to claim 11, **characterised in that** the detection device (25A) consists of a linear position sensor (27) associated with the control organ (O).

13. Linear actuator according to any of the preceding claims, **characterised in that** the motor (2) comprises a rotor (4) including N pairs of rotor poles (7) radially magnetised in an alternate direction, N being greater or equal to four, while being different from a multiple of three, the stator (3) including Px9 identical poles (8) spaced apart by 40°/P, said stator poles (8) being grouped consecutively three by three, so as to define a W-shaped circuit, grouping three consecutive stator poles (8) the central stator pole of which carries the coil (9) of the corresponding phase (10), said central stator poles (8) of two W-shaped circuits, each corresponding to a phase, being angularly spaced apart by 120°.